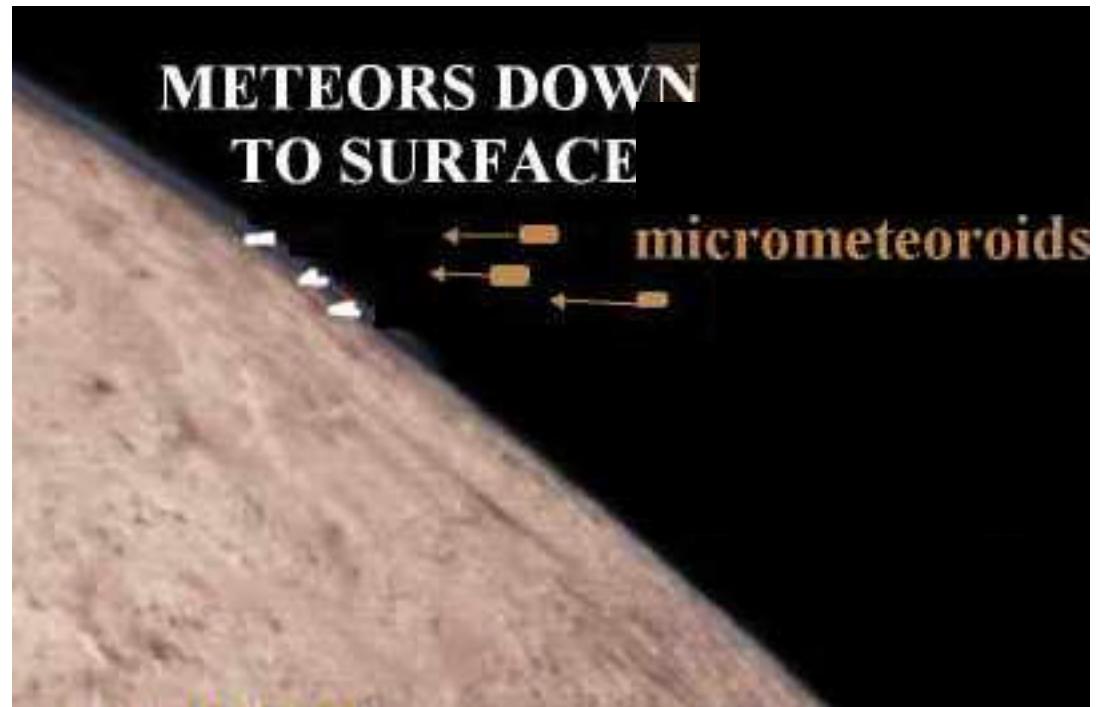




LEONID SHOWER 1833

# Meteoric Material – One of the Least Explored Components of Planetary Atmospheres



NEPTUNE'S MOON TRITON

*J. M. Grebowsky/GSFC*

*J. I. Moses/ LPI*

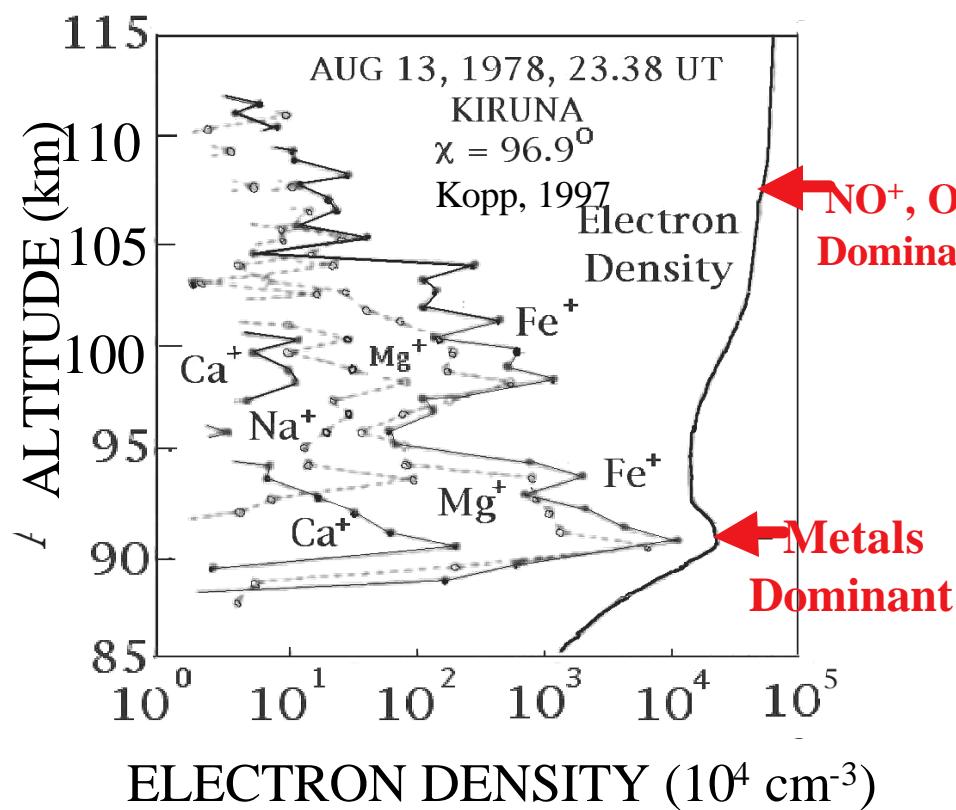
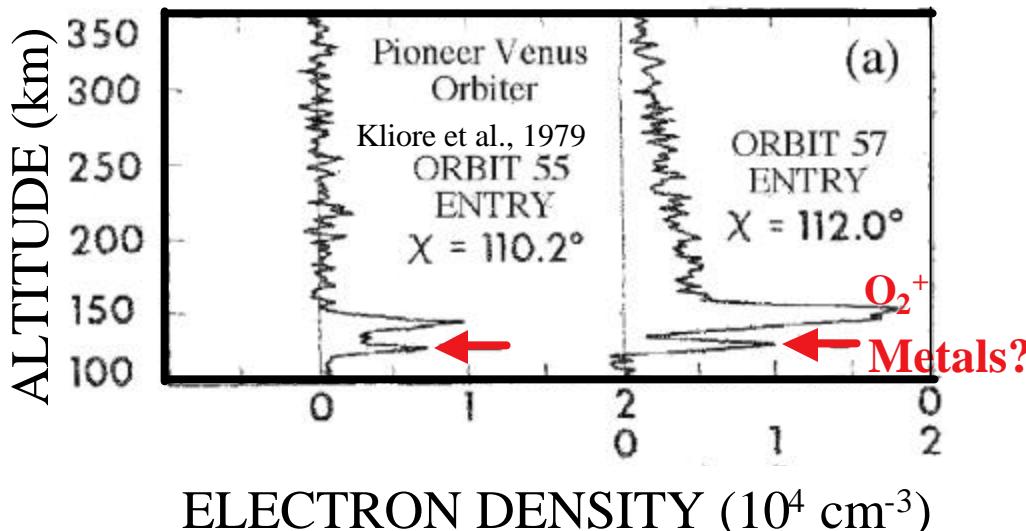
*W. D. Pesnell/Nomad Res.*

*A. L. Weisman/MD*

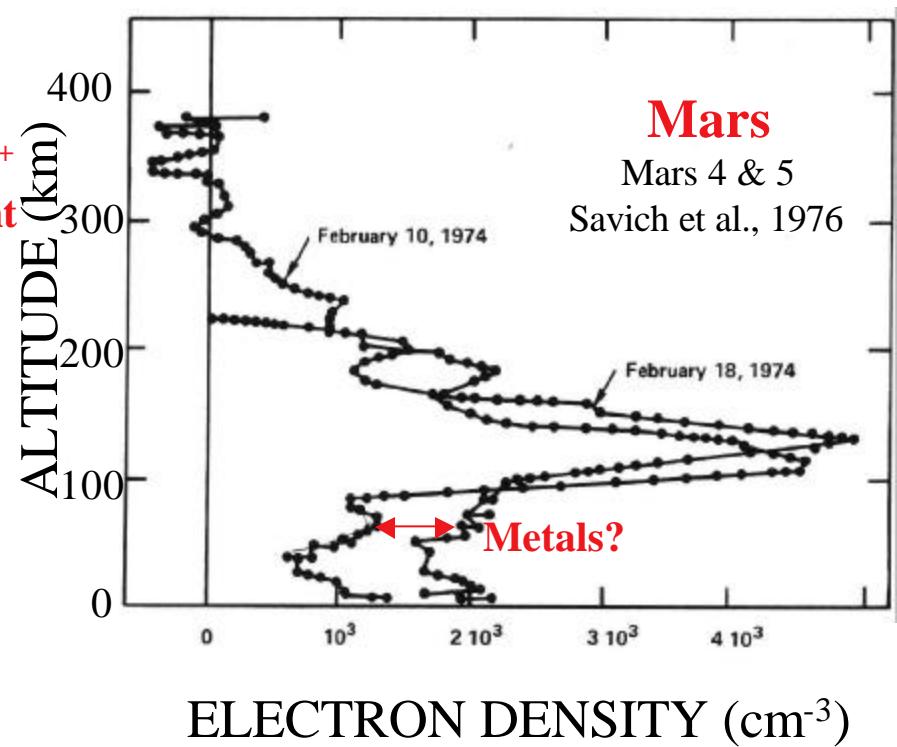
# METEORIC AERONOMY IMPORTANCE

- VISUAL EFFECTS PROVIDE ENTERTAINMENT
- METAL IONS DOMINATE IN LOW ALTITUDE LAYERS
- SOURCE OF ATMOSPHERIC NEUTRAL SPECIES
- SEEDS FOR AEROSOLS AND CLOUDS
- ATMOSPHERIC MINOR SPECIES CHEMISTRY
- METAL IONS ARE TRACERS OF DYNAMICS
- INPUTS FOR MATERIAL SCIENCE, ABLATION PHYSICS, CHEMISTRY AND SOLAR SYSTEM EVOLUTION

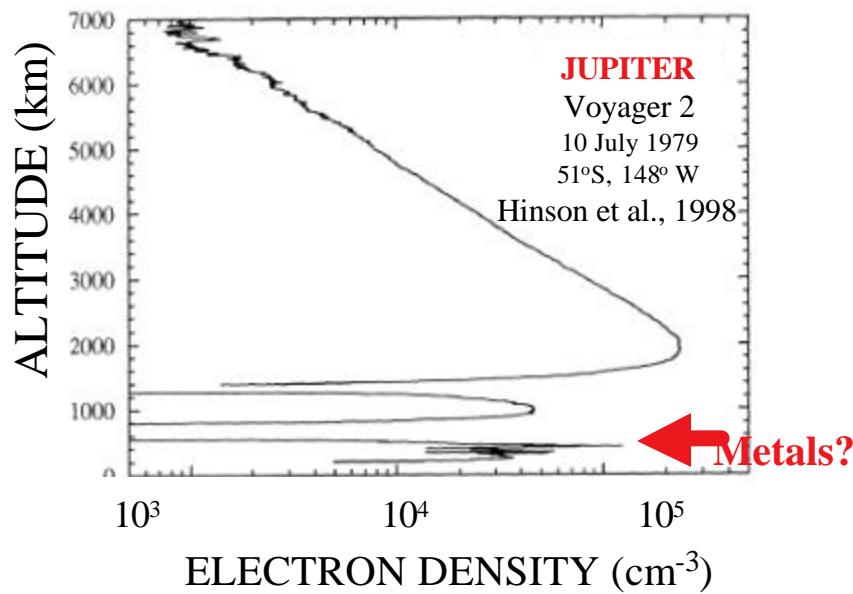
## OBSERVATIONS TERRESTRIAL PLANETS



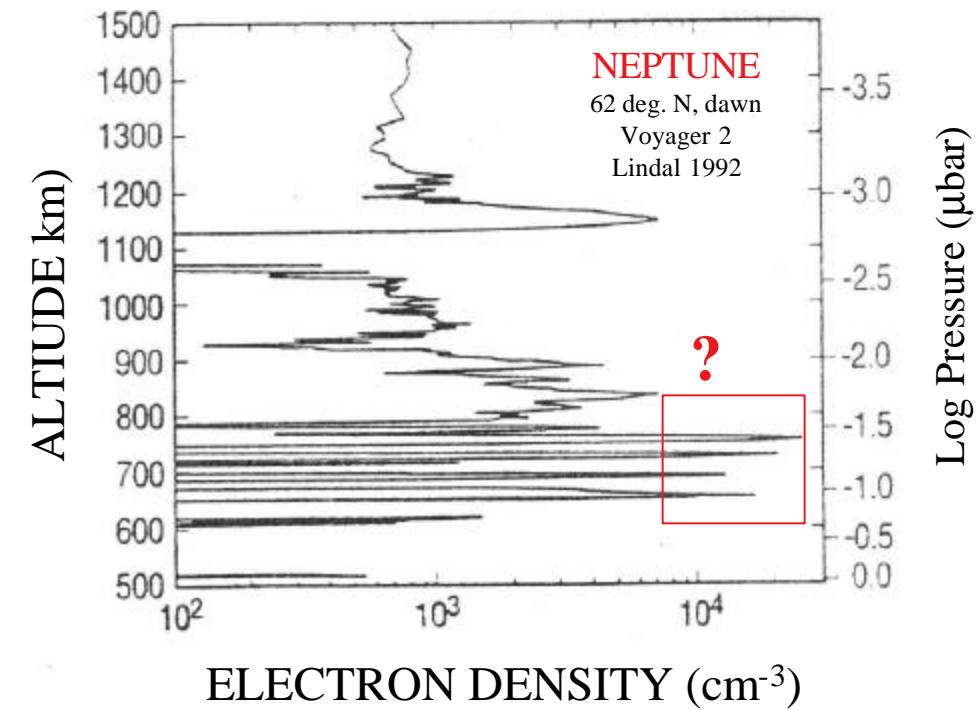
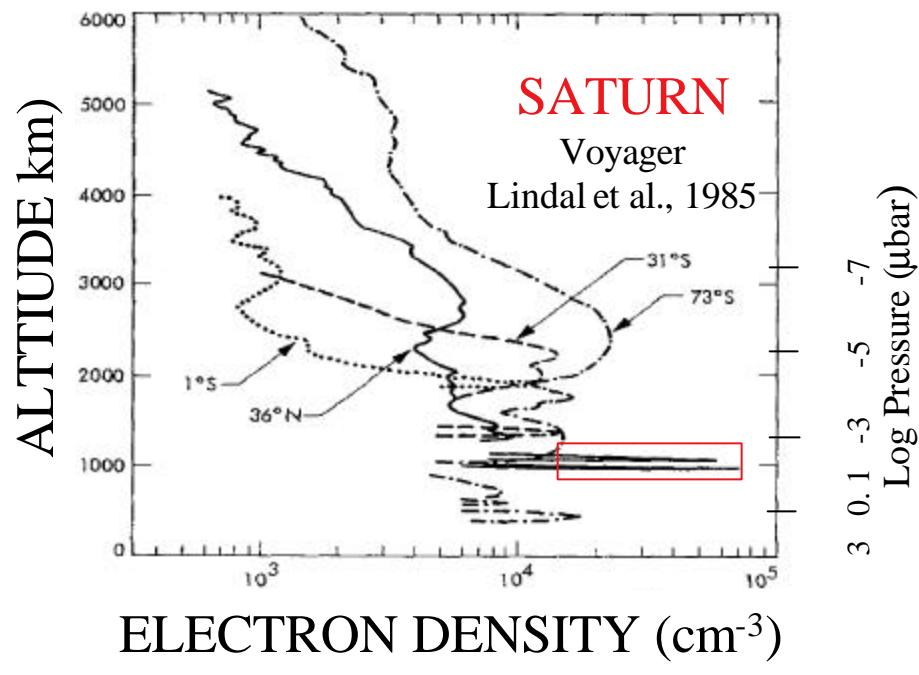
On Earth metal ion layers always present - not always the dominant ions.  
Layers can be sharp (=1km thickness).



# OBSERVATIONS OUTER PLANETS



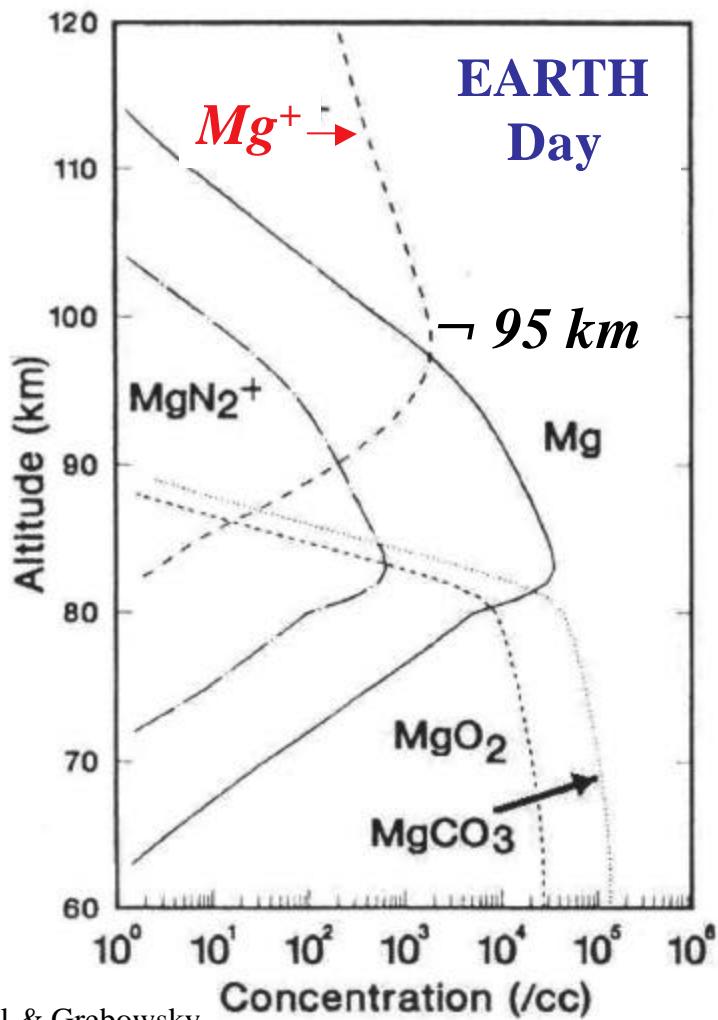
**Ionization layers detected in meteoroid ablation region.  
In all cases they are narrow & structured.**



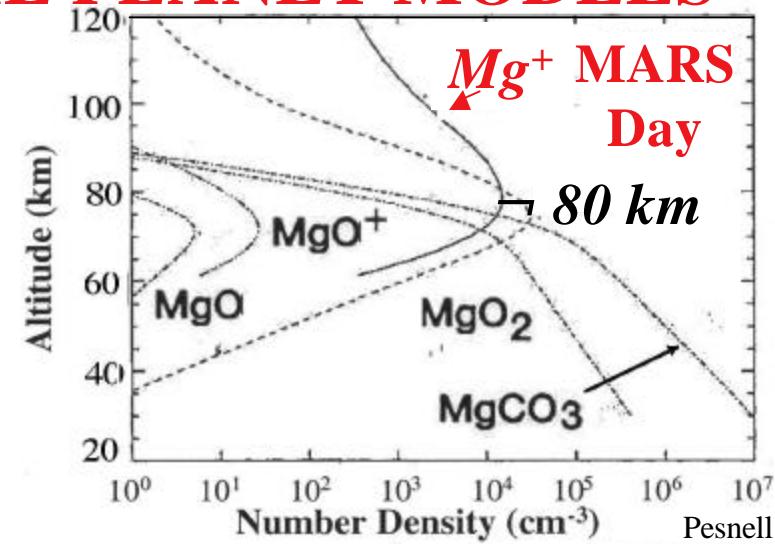
# From Dust to Ions to Dust

- Micrometeoroids (from asteroids, Kuiper belt and Oort cloud particles) approach a planetary body.
- They fall towards the body and are accelerated.
- They heat, ablating neutral species into the atmosphere.
- The fast flowing gases are impact-ionized by atmospheric collisions or are simply slowed to equilibrium.
- The neutrals diffuse, react with atmospheric species or are ionized via charge exchange or photo-ionization.
- Meteoroid species are removed by diffusion, attachment or recondensation and precipitation.

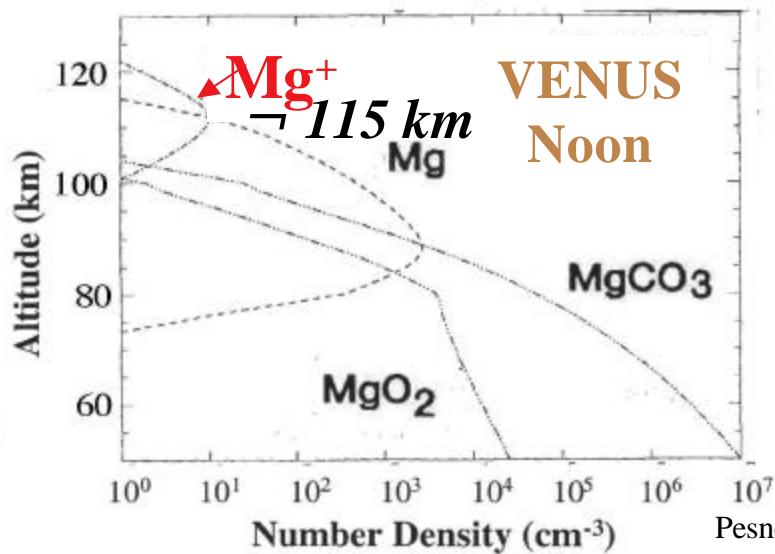
# TERRESTRIAL PLANET MODELS



Pesnell & Grebowsky  
1999



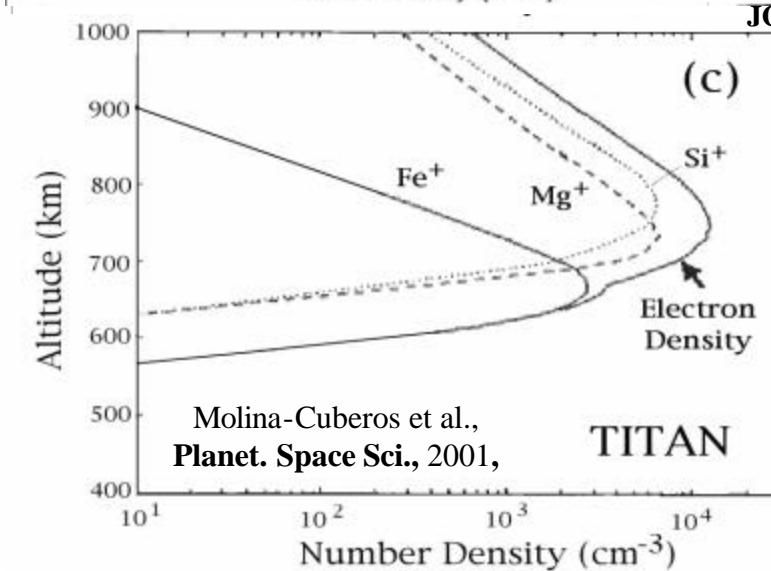
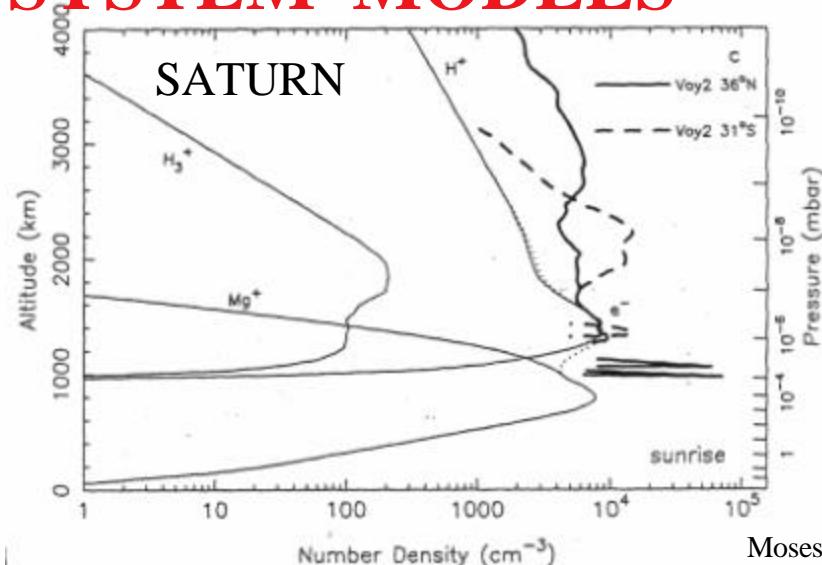
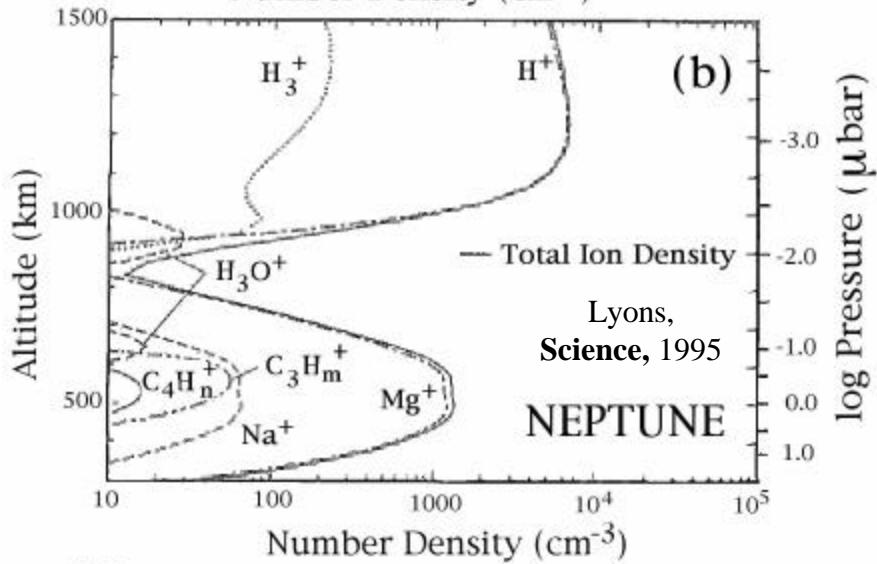
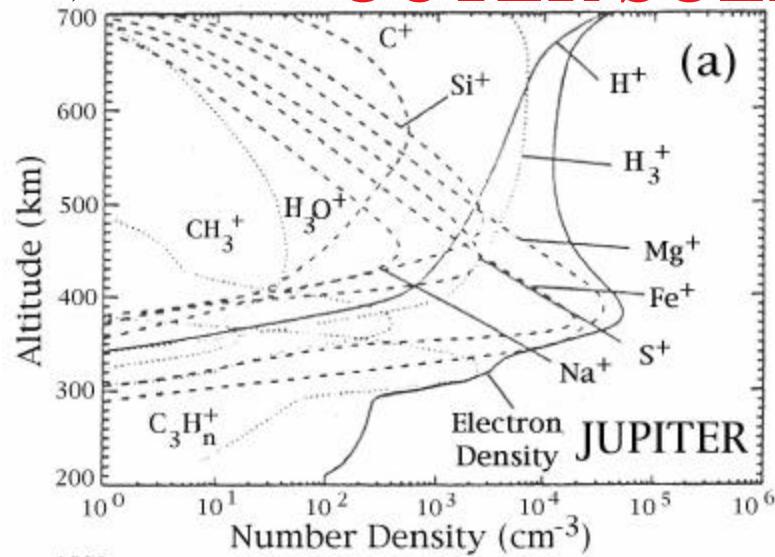
Pesnell & Grebowsky  
2000a



Pesnell & Grebowsky  
2000b

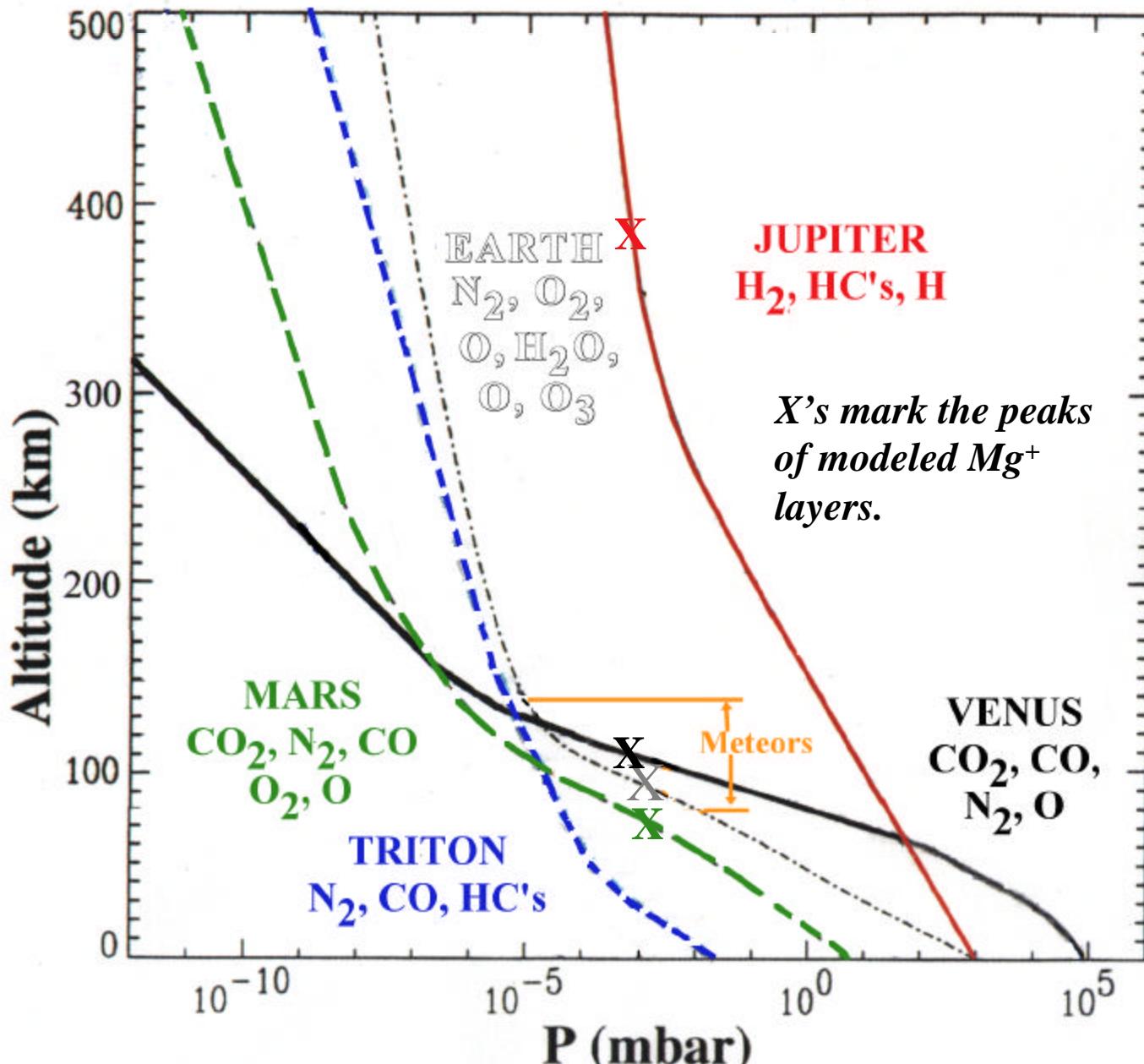
**Earth profiles are actually dominated by complex dynamics.**  
**A puzzle : Mars measurements don't show prominent low altitude ion layer, but those at Venus do - opposite to model results.**

# OUTER SOLAR SYSTEM MODELS



Outer Planet models predict nighttime layers dominated by metal ions with densities exceeding  $1000 \text{ cm}^{-3}$ . Wind shears will compress and structure layers. Metal ions also anticipated at Titan.

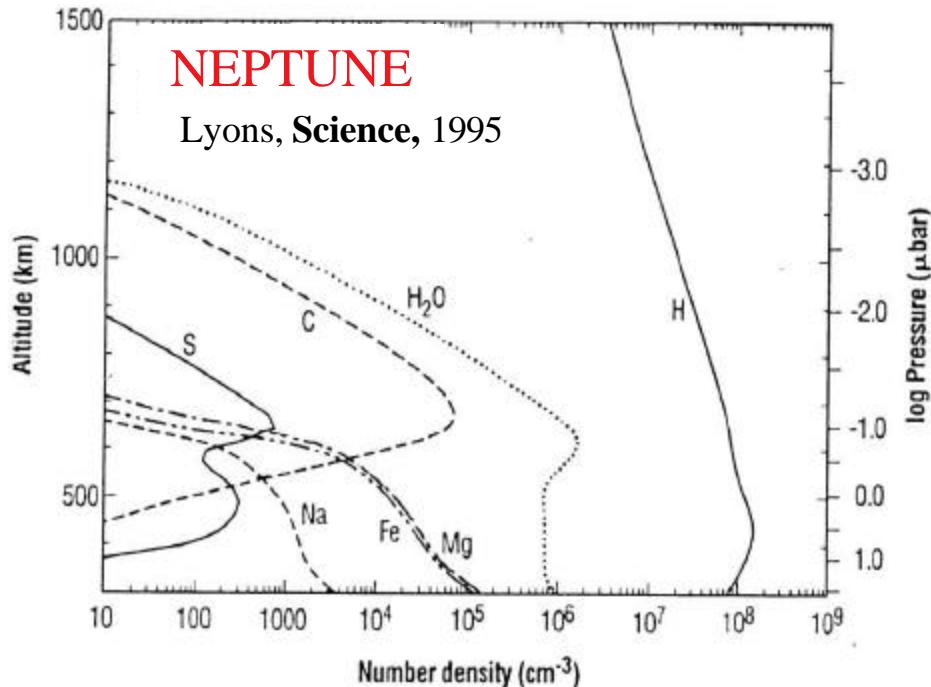
# PRESSURE LOCATION OF METEOROID IONIZATION



- All modeled meteoroid ion layers straddle 1 mbar.

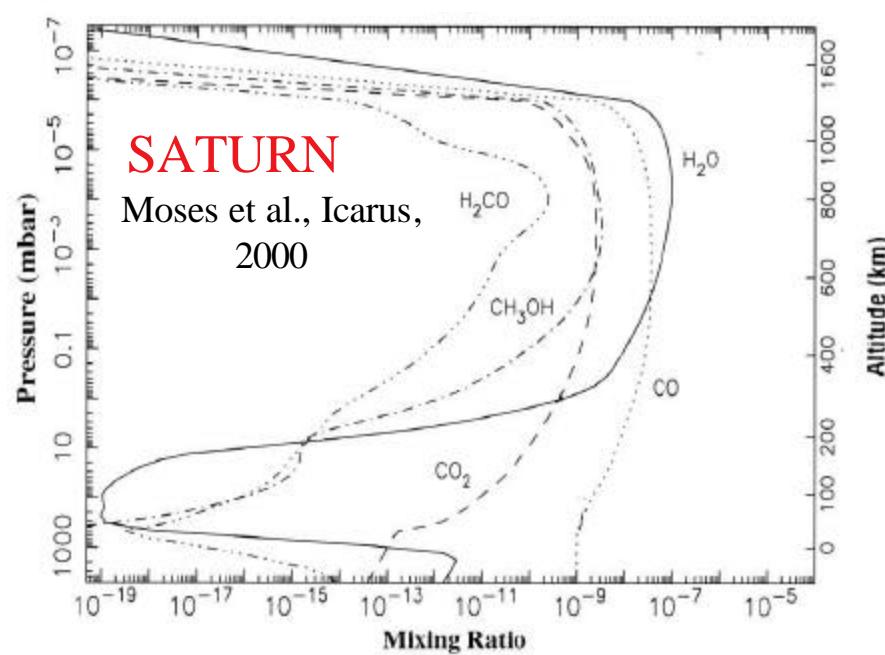
- Range where meteors are observed on Earth is indicated by orange brackets.

*Note:*  
Meteors will exist on Triton.



## OUTER PLANETS NEUTRAL DEPOSITION

Meteoroids have volatiles not present in inner solar system. They contribute to the atmospheric formation of water and carbon dioxide, as seen in the models on left.



Remote sensing of these atmospheric species can provide useful constraints on meteoroid flux inputs and composition.

# Information Most Needed

- MICROMETEOROID MASS DISTRIBUTION IN OUTER SOLAR SYSTEM
- VELOCITY DISTRIBUTIONS OF PARTICLES
- LOWER IONOSPHERE ALTITUDE DISTRIBUTIONS (TIME DEPENDENCE)
- METAL CHEMISTRY RATES IN REDUCING ATMOSPHERES
- COMPOSITION OF LOW ALTITUDE PLANETARY IONOSPHERES
- ELECTRODYNAMICS ON PLANETS WITH MAGNETIC FIELDS

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